



automatica

The Journal of IFAC the International
Federation of Automatic Control

**Volume Contents, Author and
Key Word Indexes**

Volume 25 (1989)



Pergamon Press

OXFORD · NEW YORK

BEIJING · FRANKFURT · SÃO PAULO · SYDNEY · TOKYO · TORONTO

automatica

The IFAC Journal

By an agreement between IFAC and Pergamon Press plc (the official IFAC publisher), AUTOMATICA is the official Journal of IFAC, the International Federation of Automatic Control.

IFAC Council

President B. Tamm
President-elect B. D. O. Anderson
Vice-president L. Ljung
Vice-president S. J. Kahne
Immediate Past President M. Thoma
Treasurer M. Mansour
Ordinary Members
H. Akashi
A. van Cauwenberghe
A. Fossard
G. Guardabassi
V. Kucera
P. M. Larsen
L. Lazarov
Y.-Z. Lu

Technical Board

Chairman L. Ljung
Vice-chairmen
R. W. Gellie
R. Iserman
A. H. Levis
L. Martensson

Executive Board

Chairman S. J. Kahne
Immediate Past President M. Thoma
Treasurer M. Mansour
Secretary G. Hencsey
Chairman Policy Committee J. D. N. van Wyk
Chairman Publication Committee J. Gertler
President-elect B. D. O. Anderson

Editorial Board

Chairman G. S. Axelby
Vice-chairmen
H. A. Spang III
H. Kwakernaak
Chairman Publication Committee J. Gertler
Chairman of IFAC Publications
Managing Board M. Thoma
Members
K. J. Åström
P. M. Larsen
W. S. Levine
P. C. Parks
G. F. Richards
A. P. Sage
R. E. Strange

Editor-in-Chief

George S. Axelby
Automatica
211 Coronet Drive
North Linthicum
MD 21090, U.S.A.
Tel. (301) 789-0284
Telex 9102406716
Fax (301) 636-8625

IFAC Secretariat

G. Hencsey
B. Aumann
E. Rudas

Parameter Estimation and Adaptive Control

Patrick C. Parks
Mathematics Group, School of Defence Management
Royal Military College of Science
Shrivenham, Swindon, SN6 8LA, U.K.

Large-scale Systems, Management and Decision Sciences

Andrew P. Sage
George Mason University
4400 University Drive
Fairfax, VA 22030, U.S.A.

Survey Papers

Karl J. Åström
Division of Automatic Control
Lund Institute of Technology
S-221 00 Lund 7, Sweden

Technical Communiques and Correspondence, Rapid Publications

William S. Levine
Dept of Electrical Engineering
University of Maryland, MD 20742, U.S.A.

State Estimation, Optimal Control and Systems

Huibert Kwakernaak
Faculty of Applied Mathematics
University of Twente
P.O. Box 217, 7500 AE Enschede
The Netherlands

Computer Control and Applications

H. Austin Spang III
G.E. CR&D
Box 8, KWD 220, Schenectady
NY 12301, U.S.A.

Book Reviews

Peer Martin Larsen
Electrical Power Engineering Dept
Bldg 325, Technical University of Denmark
2800 Lyngby, Denmark

Authors should send five copies of manuscripts for publication to appropriate Editor and one copy to the Editor-in-Chief with copy of letter to Editor

Associate Editors

Y. Arkun *Georgia Institute of Technology, Atlanta, GA, U.S.A.*
K.-E. Årzén *Lund Institute of Technology, Lund, Sweden*
A. Bagchi *Univ. of Twente, The Netherlands*
T. Başar *Univ. of Illinois, IL, U.S.A.*
R. Bitmead *Australian National Univ., Canberra, Australia*
R. Canales-Ruiz *Gobernador de Chihuahua 13, Collomas del Mirador, Cuernavaca, Mexico*
A. van Cauwenberghe *Rijksuniversiteit Gent, Zwijnaarde, Belgium*
J. H. Chow *G.E.-EUSED, Schenectady, NY, U.S.A.*
D. W. Clarke *Univ. of Oxford, Oxford, U.K.*
R. Curtain *Univ. of Groningen, The Netherlands*
P. Dorato *Univ. of New Mexico, Albuquerque, NM, U.S.A.*
P. M. G. Ferreira *Pontificia Univ. Católica, Rio de Janeiro, Brasil*
B. Friedland *Singer, Kearfott Div., Little Falls, NJ, U.S.A.*
P. J. Gawthrop *The University, Glasgow, U.K.*
G. C. Goodwin *Univ. of Newcastle, NSW, Australia*
G. Guardabassi *Politecnico di Milano, Milano, Italy*
Y. Y. Haimes *Univ. of Virginia, VA, U.S.A.*
C. C. Hang *Nat'l Univ. of Singapore, Singapore*
R. Isermann *Technische Hochschule Darmstadt, F.R.G.*
M. Jamshidi *Univ. of New Mexico, Albuquerque, NM, U.S.A.*
M. Johnson *Univ. of Strathclyde, Glasgow, U.K.*
S. J. Kahne *The MITRE Corp., McLean, VA, U.S.A.*

L. Keviczky *Computers and Automation Institute, Budapest, Hungary*
H. Kimura *Osaka University, Suita, Japan*
E. Kreindler *Technion-Israel Institute of Technology, Technion City, Haifa, Israel*
G. Kreisselmeier *Gesamthochschule Kassel, Kassel, F.R.G.*
V. Kučera *Czechoslovak Academy of Sciences, Prague, Czechoslovakia*
H. Kwatny *Drexel Univ., Philadelphia, PA, U.S.A.*
R. Lozano-Leal *CIEA IPN, Mexico*
I. M. Y. Mareels *Univ. of Newcastle, NSW, Australia*
J. Medanic *Mihailo Pupin Institute, Belgrade, Yugoslavia*
R. V. Patel *Concordia Univ., Montreal, Canada*
M. G. Rodd *Univ. College of Swansea, Swansea, U.K.*
T. B. Sheridan *Massachusetts Institute of Technology, Cambridge, MA, U.S.A.*
T. Söderström *Uppsala Univ., Uppsala, Sweden*
Y. Sunahara *Kyoto Institute of Technology, Kyoto, Japan*
D. Tabak *George Mason University, Fairfax, VA, U.S.A.*
H. Unbehauen *Ruhr-Univ. Bochum, Bochum, F.R.G.*
V. I. Utkin *Institute of Problems in Control, Moscow, U.S.S.R.*
L. Valavani *Massachusetts Institute of Technology, Cambridge, MA, U.S.A.*
G. Verghese *Massachusetts Institute of Technology, Cambridge, MA, U.S.A.*
B. Wittenmark *Lund Institute of Technology, Lund, Sweden*
M. I. Younis *American Univ. in Cairo, Egypt*

This staff of Associate Editors is being expanded to include representatives from various countries throughout the world

Publishing, Subscription and Advertising Offices

Subscription enquiries from customers in North America should be sent to: Pergamon Press Inc., Maxwell House, Fairview Park, Elmsford, NY 10523, U.S.A. and for the remainder of the world to: Pergamon Press plc, Headington Hill Hall, Oxford OX3 0BW, U.K.

Subscription Rates (including postage and insurance)

Annual institutional subscription rate (1990) DM 775.00. 2 year institutional rate (1990/91) DM 1472.50. Personal subscription rate (1990) DM 92.00. Prices are subject to change without notice. Six issues per annum. Copyright © 1989, International Federation of Automatic Control IFAC.

It is a condition of publication that manuscripts submitted to this journal have not been published and will not be simultaneously submitted or published elsewhere. By submitting a manuscript, the authors agree that the copyright for their article is transferred to IFAC if and when the article is accepted for publication. However, assignment of copyright is not required from authors who work for organizations which do not permit such assignment. The copyright covers the exclusive rights to reproduce and distribute the article, including reprints, photographic reproductions, microform or any other reproductions of similar nature and translations. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, electrostatic, magnetic tape, mechanical photocopying, recording or otherwise, without permission in writing from the copyright holder.

Photocopying information for users in the U.S.A. The Item-fee Code for this publication indicates that authorization to photocopy items for internal or personal use is granted by the copyright holder for libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service provided the stated fee for copying, beyond that permitted by Section 107 or 108 of the United States Copyright Law, is paid. The appropriate remittance of \$3.00 per copy per article is paid directly to the Copyright Clearance Center Inc., 27 Congress Street, Salem, MA 01970.

Permission for other use. The copyright owner's consent does not extend to copying for general distribution, for promotion, for creating new works, or for resale. Specific written permission must be obtained from the publisher for such copying.

The Item-fee Code for this publication is: 0005-1098/89 \$3.00 + 0.00

Microform Subscriptions and Back Issues

Back Issues of all previously published volumes are available direct from Pergamon Press offices.

©TM The paper used in this publication meets the minimum requirements of American National Standard for Information Sciences—Permanence of Paper for Printed Library Materials, ANSI Z39.48-1984.

Volume Contents

Number 1 — January

		PAPERS
C. C. Hang, K. W. Lim and B. W. Chong	1	A Dual-rate Adaptive Digital Smith Predictor
S. A. Hall	17	Real-time Control of a Nonlinear Electromagnetic Actuator
G. A. Dumont, J. M. Martin-Sánchez and C. C. Zervos	33	Comparison of an Auto-tuned PID Regulator and an Adaptive Predictive Control System on an Industrial Bleach Plant
M. J. Grimble, S. De La Salle and D. Ho	41	Relationship Between Internal Model Control and LQG Controller Structures
D. Ghosh and C. H. Knapp	55	Measurement Selection for Linear Multivariable Control Systems
H. K. Khalil and Y.-N. Hu	65	Steering Control of Singularly Perturbed Systems: a Composite Control Approach
S.-C. Chang, T.-S. Chang and P. B. Luh	77	A Hierarchical Decomposition for Large-scale Optimal Control Problems with Parallel Processing Structure
M. Deistler and M. Gevers	87	Properties of the Parametrization of Monic ARMA Systems
		BRIEF PAPERS
M. Parlar	97	Solving Dynamic Optimization Problems on a Personal Computer using an Electronic Spreadsheet
O. Begovich and R. Ortega	103	Adaptive Head Control of a Hydraulic Open Channel Model
A. Vicino	109	Robustness of Pole Location in Perturbed Systems
Y. C. Soh and R. J. Evans	115	Characterization of Robust Controllers
S. Skogestad and M. Morari	119	Robust Performance of Decentralized Control Systems by Independent Designs
J. L. Willems	127	Time-varying Feedback for the Stabilization of Fixed Modes in Decentralized Control Systems
M. Ulm and H.-D. Wend	133	A Concept for Parameter Independent Evaluation of Decentralized Stabilizability
J. L. Calvet and A. Titli	137	Overlapping vs Partitioning in Block-iteration Methods: Application in Large-scale System Theory
L. Guo, H.-F. Chen and J.-F. Zhang	147	Consistent Order Estimation for Linear Stochastic Feedback Control Systems (CARMA Model)
		TECHNICAL COMMUNIQUE
R. H. Kwong and T. J. Richardson	153	Comments on: "Existence Conditions of Positive-definite Solutions for Algebraic Matrix Riccati Equations"
		BOOK REVIEWS
P. C. Parks	155	Stability of Adaptive Systems: Passivity and Averaging Analysis by B. D. O. Anderson, R. R. Bitmead, C. R. Johnson, Jr, P. V. Kokotovic, R. L. Kosut, I. M. Y. Mareels, L. Praly and B. D. Riedle
A. P. Sage	156	Linear Control Systems—a Computer-aided Approach by M. Jamshidi and M. Malek-Zavarei
	159	<i>Biographical Notes on Contributors to this Issue</i>

Number 2 — March

A. G. J. MacFarlane, G. Gruebel and J. Ackermann	165	PAPERS Future Design Environments for Control Engineering
M. Papageorgiou and A. Messmer	177	Flow Control of a Long River Stretch
Y. Nakamori	185	Development and Application of an Interactive Modeling Support System
L. Pau	207	Knowledge Representation Approaches in Sensor Fusion
D.-W. Gu, M. C. Tsai and I. Postlethwaite	215	An Algorithm for Super-optimal H^∞ Design: the Two-block Case
J. L. Menaldi and M. I. Taksar	223	Optimal Correction Problem of a Multidimensional Stochastic System
P. Tatjewski	233	New Dual-type Decomposition Algorithm for Nonconvex Separable Optimization Problems
G. Yi, Y. B. Hwang, H. N. Chang and K. S. Lee	243	BRIEF PAPERS Computer Control of Cell Mass Concentration in Continuous Culture
G. Baoping and H. Baosheng	251	The Application and Expansion of the Input-Output Consumption-tracking Control Model
G. Roppenecker and J. O'Reilly	259	Parametric Output Feedback Controller Design
A. F. Vaz and E. J. Davison	267	The Structured Robust Decentralized Servomechanism Problem for Inter-connected Systems
J. Maršik and V. Strejc	273	Application of Identification-free Algorithms for Adaptive Control
J. C. Engwerda and P. W. Otter	279	On the Choice of Weighting Matrices in the Minimum Variance Controller
P. A. Ioannou and G. Tao	287	Dominant Richness and Improvement of Performance of Robust Adaptive Control
J. C. Geromel	293	Global Optimization of Measurement Strategies for Linear Stochastic Systems
K. Khorasani	301	A Slow Manifold Approach to Linear Equivalents of Nonlinear Singularly Perturbed Systems
C. Kambhampati, J. E. Ellis and P. D. Roberts	307	Generalization of Integrated System Optimization and Parameter Estimation Techniques
H. A. Barker, M. Chen, P. W. Grant, C. P. Jobling and P. Townsend	311	A Man-Machine Interface for Computer-aided Design and Simulation of Control Systems
G. E. Young and X. J. Tao	317	TECHNICAL COMMUNIQUE A Short-cut to the Mobius Transformation with a Recursive Algorithm
W. Ehrenberger	321	BOOK REVIEWS Reliability of Computers and Control Systems by N. Viswanadham, V. V. S. Sarma and M. G. Singh
V. Kucera	322	Control System Design: Conventional, Algebraic and Optimal Methods by Chi-Tsong Chen
B. Schmidtbauer	323	Microprocessor-based Control Systems by N. K. Sinha
	325	<i>Biographical Notes on Contributors to this Issue</i>

Number 3 — May

G. S. Axelby and P. C. Parks	333	EDITORIAL Two Golden Jubilees
C. E. García, D. M. Prett and M. Morari	335	SURVEY PAPER Model Predictive Control: Theory and Practice—a Survey

S. T. Weingaertner and A. H. Levis	349	PAPERS
K. C. Chang and Y. Bar-Shalom	359	Analysis of Decision Aiding in Submarine Emergency Decisionmaking
B. R. Barmish and Z. Shi	371	Distributed Adaptive Estimation with Probabilistic Data Association
L. Pronzato and E. Walter	383	Robust Stability of Perturbed Systems with Time Delays
Z. Kowalczyk	393	Experiment Design in a Bounded-error Context: Comparison with D-Optimality
D. W. Pessen	407	Finite Register Length Issue in the Digital Implementation of Discrete PID Algorithms
D. M. Stimler	413	BRIEF PAPERS
M. S. Mahmoud	421	Ladder-diagram Design for Programmable Controllers
P. Dorato, H.-B. Park and Y. Li	427	Scheduling Turbofan Engine Control Set Points by Semi-infinite Optimization
B.-S. Chen and T.-Y. Dong	431	Dynamic Decentralized Stabilization for a Class of Multi-stage Processes
M. H. Verhaegen	437	An Algorithm for Interpolation with Units in H^∞, with Applications to Feedback Stabilization
L. Wehenkel, Th. Van Cutsem and M. Ribbens-Pavella	445	LQG Optimal Control System Design Under Plant Perturbation and Noise Uncertainty: a State-space Approach
D. J. Hill and C. N. Chong	453	Round-off Error Propagation in Four Generally-applicable, Recursive, Least-squares Estimation Schemes
G. N. Saridis	461	Inductive Inference Applied to On-line Transient Stability Assessment of Electric Power Systems
J. J. Buckley and H. Ying	469	Lyapunov Functions of Lur'e-Postnikov Form for Structure Preserving Models of Power Systems
D. Kraft	473	Analytic Formulation of the Principle of Increasing Precision with Decreasing Intelligence for Intelligent Machines
N. K. Sinha	475	Fuzzy Controller Theory: Limit Theorems for Linear Fuzzy Control Rules
P. J. Gawthrop	476	BOOK REVIEWS
Cs. Bányász	478	Optimal Control and Stochastic Estimation, Volumes 1 and 2 by M. J. Grimble and M. A. Johnson
	481	System Identification—Theory for the User by Lennart Ljung
		Identification of Continuous Systems by H. Unbehauen and G. P. Rao
		Continuous-time Self-tuning Control. Volume 1—Design by P. J. Gawthrop
		Biographical Notes on Contributors to this Issue

Number 4 — July

T. B. Sheridan	487	PAPERS
J.-J. E. Slotine and W. Li	509	Telerobotics
E. Mosca, G. Zappa and J. M. Lemos	521	Composite Adaptive Control of Robot Manipulators
T. Yoshida and K. A. Loparo	531	Robustness of Multipredictor Adaptive Regulators: MUSMAR
S. S. Stanković and D. D. Šiljak	545	Quadratic Regulatory Theory for Analytic Non-linear Systems with Additive Controls
J. Lunze	561	Sequential LQG Optimization of Hierarchically Structured Systems
B. Kuipers	571	Stability Analysis of Large-scale Systems Composed of Strongly Coupled Similar Subsystems
		Qualitative Reasoning: Modeling and Simulation with Incomplete Knowledge

V. Kaitala	587	BRIEF PAPERS Nonuniqueness of No-memory Feedback Equilibria in a Fishery Resource Game
J. Zhang and S. Lang	593	Explicit Self-tuning Control for a Class of Non-linear Systems
M. Niedźwiecki	597	Steady-state and Parameter Tracking Properties of Self-tuning Minimum Variance Regulators
W. Gersch and G. Kitagawa	603	Smoothness Priors Transfer Function Estimation
R. M. Canetti and M. D. España	609	Convergence Analysis of the Least-squares Identification Algorithm with a Variable Forgetting Factor for Time-varying Linear Systems
H. Dai, N. K. Sinha and S. C. Puthenpura	613	Robust Combined Estimation of States and Parameters of Bilinear Systems
K. Demirbaş	617	Multidimensional State Estimation using Stacks for Dynamic Systems with Interference
M. Sznaier and M. J. Damberg	623	Control of Constrained Discrete Time Linear Systems Using Quantized Controls
C. Ganesh and J. B. Pearson	629	H^2 -Optimization with Stable Controllers
M. J. Grimble	635	Minimization of a Combined H_∞ and LQG Cost-function for a Two-degrees-of-freedom Control Design
A. Bagchi	639	BOOK REVIEWS Stochastic Differential Systems—Analysis and Filtering by V. S. Pugachev and I. N. Sinitsyn
S. Pohjolainen	640	Mobile Control of Distributed Parameter Systems by A. G. Butkovskiy and L. M. Pustyl'nikov
G. Weir	642	Tasks, Errors and Mental Models by L. P. Goodstein, H. B. Andersen and S. E. Olsen
	645	<i>Biographical Notes on Contributors to this Issue</i>

Number 5 — September

R. Ortega and Y. Tang	651	SURVEY PAPER Robustness of Adaptive Controllers—a Survey
R. Bansal and T. Başar	679	PAPERS Simultaneous Design of Measurement and Control Strategies for Stochastic Systems with Feedback
S. Wegrzyn, J. C. Gille and P. Vidal	695	A Model for Developmental Systems—I. Generating Word Without any Operating System
J. C. Gille, S. Wegrzyn and P. Vidal	707	A Model for Developmental Systems—II. Generating Word With an Operating System
O. K. Kwon, W. H. Kwon and K. S. Lee	715	FIR Filters and Recursive Forms for Discrete-time State-Space Models
L. Saydy and G. L. Blankenship	729	A Bound Approach to Asymptotic Optimality in Non-linear Filtering of Diffusion Processes
R. Tenno, R. Vilu and H. Oit	739	BRIEF PAPERS Stochastic Control for Stabilization of Sludge Loading Characteristics in an Aerobic Waste Water Treatment System
M. Bryds, P. D. Roberts, M. M. Badi, I. C. Kokkinos and N. Abdullah	743	Double Loop Iterative Strategies for Hierarchical Control of Industrial Processes
P. Albertos and R. Ortega	753	On Generalized Predictive Control: Two Alternative Formulations
F. Casiello and K. A. Loparo	757	Optimal Policies for Passive Learning Controllers
S. Van Huffel and J. Vandewalle	765	On the Accuracy of Total Least Squares and Least Squares Techniques in the Presence of Errors on all Data

D. Hinrichsen, B. Kelb and A. Linnemann	771	An Algorithm for the Computation of the Structured Complex Stability Radius
G. Gu and E. B. Lee	777	Stability Testing of Time Delay Systems
A. W. Berger and F. C. Schweppe	781	Existence of Coordinating Prices in Dynamic Systems
H. Tolle	785	BOOK REVIEWS Robot Dynamics Algorithms by Roy Featherstone
H. J. Zimmermann	787	Fuzzy Sets and Applications: Selected Papers by L. Zadeh by R. R. Yager, S. Ovchinnikov, R. M. Tong and H. T. Nguyen
A. Halme	788	Discrete-time Control Systems by K. Ogata
B. Wittenmark	789	Process Control Systems, Application, Design and Tuning, 3rd Ed. by F. G. Shinskey
H.-H. Wilfert	790	Mess- und Regelungstechnik. Mathematische Grundlagen, Entwurfsmethoden, Beispiele by Hans P. Geering
	791	Biographical Notes on Contributors to this Issue

Number 6 — November

P. Eykhoff and P. C. Parks	797	Announcement: Special Issue of <i>Automatica</i> on "Identification and Systems Parameter Estimation"
K. J. Åström	798	Announcement: <i>Automatica</i> Prize Paper Awards
R. Doraiswami and J. Jiang	799	EXPERT, KNOWLEDGE-BASED SYSTEMS Performance Monitoring in Expert Control Systems
K.-E. Årzén	813	An Architecture for Expert System Based Feedback Control
J. L. Alty and G. Johannsen	829	Knowledge-based Dialogue for Dynamic Systems
D. Metz and D. Williams	841	PAPERS Near Time-optimal Control of Racing Vehicles
D. W. Clarke and C. Mohtadi	859	Properties of Generalized Predictive Control
R. Ortega and M. W. Spong	877	Adaptive Motion Control of Rigid Robots: a Tutorial
R. H. Middleton, G. C. Goodwin and Y. Wang	889	On the Robustness of Adaptive Controllers Using Relative Deadzones
B. Pourbabai	897	Optimal Selection of Buffers in a Tandem Finite Capacity $G/M/1$ Queueing System
S. Li and Y.-C. Ho	907	Sample Path and Performance Homogeneity of Discrete Event Dynamic Systems
K. Y. Choi and D. N. Butala	917	BRIEF PAPERS Synthesis of Open-loop Controls for Semibatch Copolymerization Reactors by Inverse Feedback Control Method
J. B. Moore and L. Xia	925	On a Class of Stabilizing Partially Decentralized Controllers
R. I. Badr, M. F. Hassan, J. Bernussou and A. Y. Bilal	935	Stability and Performance Robustness for Multivariable Linear Systems
C. Wen and D. J. Hill	943	Robustness of Adaptive Control Without Deadzones, Data Normalization or Persistence of Excitation
E. Walter, L. Pronzato and A. Venot	949	Theoretical Properties of Sign Change Criteria for Robust Off-line Estimation
B. Lennartson	953	BOOK REVIEWS Singular Perturbation Methods in Control: Analysis and Design by Petar Kokotović, Hassan K. Khalil and John O'Reilly

F. J. Evans	955	Multivariable Control—a Graph Theoretic Approach by K. J. Reinschke
M. Thoma	956	Multivariable Control for Industrial Application by John O'Reilly (Editor)
D. Franke	957	Sensors and Controls in the Analysis of Distributed Systems by A. El Jai and A. J. Pritchard
	959	<i>List of Reviewers for Automatica, 1988</i>
	963	<i>Biographical Notes on Contributors to this Issue</i>
	i	<i>Index to Volume 25 (1989)</i>

